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Manis temminckii.

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Manis temminckii Smuts, 1832

Cape Pangolin

Manis temminckii Smuts, 1832:54. Type locality "E regionibus, ultra *Lattakou* sitis, allatum est; at suum nunc inter rariora obtinet locum, in splendidissimo Museo *Regio* hujus urbis [It was brought from the lands that lie beyond Lattakou (=Latukou, near Kuruman in northern Cape Province, South Africa); and now has its place among the rarer animals, in the magnificent Royal Museum of this city]."

Phatages hedenborgii Fitzinger, 1872:69.

CONTEXT AND CONTENT. Order Pholidota, Family Manidae, Genus *Manis*. This genus contains seven extant species; *M. crassicaudata, M. gigantea, M. javanica, M. longicaudata* (=*tetradactyla*), *M. pentadactyla, M. temminckii,* and *M. tricuspis*. Generic context and content and a key to the species are presented in Heath (1992). There are no subspecies for *M. temminckii.*

DIAGNOSIS. There are two ground pangolin in Africa: *Manis temminckii* and *M. gigantea. M. temminckii* (Fig. 1) is smaller, has a longer tail, and has a different number of scales on the body and tail than *M. gigantea* (Jentink, 1882; Meester, 1971). The length of the head and body and the length of the tail of *M. temminckii* are <700 mm (Meester, 1971). Of 36 specimens of 4.6–15.9 kg mass from Zimbabwe none had tail or head and body lengths >550 mm (Coulson, 1989). The length of the skull of *M. temminckii* (Fig. 2), reported as up to 98.3 mm in length (Coulson, 1989), is smaller than in *M. gigantea.* There are 11–13 rows of scales both on the body and on the margin of the tail (Coulson, 1989; Meester, 1971; Sweeney, 1974). The end of the tail is rounded. *M. temminckii* also lacks the entepicondylar foramen of the humerus which is present in other ground pangolins (Emry, 1970).

GENERAL CHARACTERS. *Manis temminckii* has no teeth. It is a medium-size mammal with an elongate, streamlined body and anatomical adaptations for procuring and eating ants and termites. The head is small and cone-shaped, blending into the thicker streamlined body without an identifiable neck. Large (2–5 cm) overlapping yellow-brown scales, made of agglutinated (fused) hair, cover the dorsal and lateral surfaces, both sides of the tail, and the outer surface of the legs. The ventrum of the head and trunk and the inside of the legs are covered with sparse hair. When the Cape pangolin rolls into a sphere as defense, only sharp scales are exposed to predators (Haltenorth and Diller, 1977; Kingdon, 1974; Pocock, 1924).

FIG. 1. Adult *Manis temminckii.* At Chipengali Wildlife Orphanage, Bulawayo, Zimbabwe. Photo by Vivian Wilson.

The forelegs are strong with long, robust claws, resembling those of the anteaters of South America. The central three front claws are up to 5 cm long and function in tearing apart ant and termite nests and digging burrows. The hind legs are shorter and stouter than the forelegs and have short claws. All the limbs have five digits. When walking quadrupedally, the long front claws, used for digging, curl under and the animal walks on its knuckles or wrist. The tail is thick, with a rounded dorsal surface and flat ventral surface, prehensile, and very muscular (Kingdon, 1974).

Manis temminckii has an ear opening but no ear pinna. Small eyes protected by thick eyelids are present but vision is poor. An acute olfactory sense is used to locate food and mates, and to monitor their environment (Sweeney, 1956). A conical tongue that is thin and long is used for lapping up prey (Kingdon, 1974; Sweeney, 1974).

Males are larger than females. The mass of 36 adult specimens from Zimbabwe is 4.6–10.09 kg for females and 10.7–15.9 kg for males. Measurements (mm) for female and male adults are: head and body length, 447–470, 495–550; tail length, 395–420, 438–

FIG. 2. Dorsal, ventral, and lateral views of the cranium and lateral view of the mandible of female *Manis temminckii* (American Museum of Natural History, New York, 83609, from Transvaal, South Africa). Greatest length of cranium is 75.4 mm.

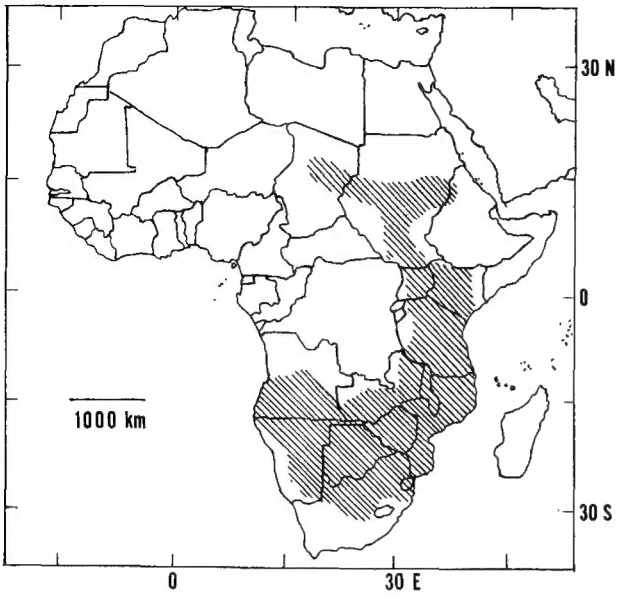

FIG. 3. Present distribution of *Manis temminckii*.

520; total length, 770–1,040, 933–1,289 (Coulson, 1989; Jacobson et al., 1991). Other recorded body masses include a 7.94 kg (gender undetermined) individual from eastern Zambia (Wilson, 1968), a 7.0-kg female and 8.2-kg male from Chilanga (Ansell, 1964), a 16.8-kg specimen from Kafue National Park in Southern Zambia (Ansell, 1964), and a 21-kg specimen from Sudan (Sweeney, 1974). The height of this latter pangolin when standing on all fours is about 35 cm. *M. temminckii* from Sudan weigh as much as 27.3 kg (Sweeney, 1956), but there are no other reports of body mass this great.

DISTRUBUTION. *Manis temminckii* occurs throughout much of southern and eastern Africa, with the range extending from the cape northward into northeastern Chad (Malbrant, 1952) and much of Sudan (Stuart, 1980; Sweeney, 1974; Fig. 3). *M. temminckii* is absent from Saharan and Western Africa (Stuart, 1980). It lives at elevations as high as 1,700 m (Coulson, 1989).

FOSSIL RECORD. Pholidotes radiated from the eutherian mammal lineage in the Cretaceous. They may share a common ancestor with edentates in the North American Palaeanodonta (Emry, 1970; Matthew, 1918; Patterson, 1978). Others believe that the resemblance to other ant-eating mammals is because of convergent evolution (Eisenberg, 1981; Griffiths, 1968).

Fossil records exist for pangolins in Europe from the Middle Eocene (*Eomanis waldi*: Storch, 1978; Von Koenigswald et al., 1981), Oligocene (*Necromanis quercyi* and *Leptomanis edwardsi*: Filhol, 1894; *Teutomanis franconica*: Quenstedt, 1885), and post-Miocene periods (*Manis hungrarica*: Kormos, 1934). There is one fossil record of a pangolin in North America (*Patriomanis americanus*: Emry, 1970; Patterson, 1978). Fossil records from Asia include *Manis lydekkeri* (Dubois, 1908) and *Manis palaeojavanica* (Dubois, 1907). The latter is larger than any of the extant species. Patterson (1978) suggested that pangolins emigrated to Africa from Eurasia in the late Oligocene Epoch about 22 million years ago.

There is a late Pleistocene specimen of *M. temminckii* from the Nelson Bay Cave (unit YGL, dated at ca. 18,000 B.P.), South Africa (Klein, 1972). Postcranial bones from the Pliocene were found at Langabaanweg, in Bed 2 of the Varswater Formation (E Quarry), and a braincase from the middle Pleistocene came from Elandsfontien (Hendey, 1973).

FORM. *Manis temminckii* is covered with yellow-brown artichoke-like overlapping scales. The arrangement of scales on the trunk is from the dorsal mid-line outward, whereas scale arrangement is horizontal on the forelegs and vertical on the hind legs (Jentink, 1882). Cape pangolins also have a muscular tail that is long and thick and wraps neatly around a curled-up pangolin. The edge of the tail is defined by scales that are folded along their mid-line, pointed, and sharp. The skin and scales of ground pangolins make up ¼ to ⅓ of their total body mass (Kingdon, 1974) and thus represent a large investment. Scales provide little insulation or protection from external parasites, but they require no grooming. Scales afford effective protection for the skin against scratches from underbrush or sharp rocks along burrow walls and from predators. Scale size, shape, and ridge pattern are different for each species (Grassè, 1955; Kuehn, 1986). There is also intraspecific variation in the number and pattern of scales on the tail, head, or trunk region (Jentink, 1882).

Manis temminckii has anatomical features specialized for feeding on ants and termites. The small mouth is toothless with thin jawbones (Fig. 2). *M. temminckii* ingests ants and termites with a long (25–40 cm), thin (5 mm) cone-shaped tongue that is slightly flattened toward the end. The tongue extends 10–15 cm beyond the lips and retracts into a sheath (pouch) in the throat when not in use. A complicated system of muscles allows for this movement. The tongue divides caudally into two musculotendinous roots in the posterior part of the pharynx (Jentink, 1882; Kuehn, 1986). These roots originate from a fibrinous sheath that is next to the esophagus and end at the distal part of the xiphisternum (Griner, 1983). The xiphisternum is elongate and formed from the last pair of cartilaginous ribs. These ribs have lost their attachment to the vertebrae and have migrated ventrally so that they extend from the sternum to the pelvic region (Kingdon, 1974). The xiphisternum follows the ventral abdominal wall to near the pelvis and then makes an arc to the dorsal abdominal wall and ends at the pelvis near the kidneys (Jentink, 1882; Kuehn, 1986). There are large salivary glands in the pharyngeal and cervical regions that extend almost to the shoulder (Kuehn, 1986; Griner, 1983). These glands secrete a tenacious mucus into the tongue sheath and on the tongue. The stomach has a large storage area and a hard knobby structure preceding the pylorus that macerates the food before it passes the pyloric valve (Weber, 1892).

The mandibles are thin and flimsy, without angular processes, and show only slight contact with the ventro-medial aspect of the zygomatic process. The skull is conical. Interparietal, jugal, and lacrimal bones are absent in *M. temminckii*. The frontals are larger than the parietals. The nasals and supraoccipitals are large, the palate is long and narrow, and the pterygoids are separate and external to the bulla. The lambdoid crest of the skull is present only posteriorly. There is small median vertical crest which descends from the center of the lambdoid crest (Emry, 1970).

The orbital and temporal fossae are confluent. There is a foramen between the petrosal and basisphenoid that traverses the median aspect of the otic cavity through which the inferior petrosal sinus probably passes. Medial and anterior to this foramen is a groove that marks the path of the vidian branch of the seventh nerve (Emry, 1970).

The pelvis of *M. temminckii* is more vertical and the tuber coxae are more prominent than in other pangolins. This emphasizes its greater use of the hind legs for weight bearing (Kingdon, 1974). The number of vertebrae in *M. temminckii* is 48: 7 cervical, 12 thoracic, 5 lumbar, 3 sacral, and 21 caudal vertebrae (Jentink, 1882).

Retia mirabilia are present in axis of the limbs. There are some parallel blood vessels next to the spinal cord which run the length of the body, but their purpose is unknown (Kingdon, 1974).

The brain of *M. temminckii* is small and has a simple serial configuration with convoluted cerebral hemispheres that do not overlap either the olfactory bulbs or the cerebellum. The well-developed olfactory lobes are short, level with the cerebral hemispheres, and without neural fibers entering dorsally. The cerebellum is relatively large and well differentiated with the vermis and lateral lobes of the cerebellum similar in size. A bony projection of the skull protrudes between the cerebrum and cerebellum (Grassè, 1955; Kowalski, 1971). Morphology of the brain suggests that the Asian species of pangolin are more primitive than the African species (Hackethal, 1976).

Males have a well-developed penis. The testes pass through the inguinal canal at sexual maturity and enlarge in a fold of skin in the groin. They do not descend into a scrotum. Female pangolins have two pectoral mammae about 1-cm long (van Ee, 1966). The uterus is bicornuate and the placenta is diffuse and nondeciduate (Grassè, 1955; Kowalski, 1971). The physiology of *M. temminckii* has not been studied.

ONTOGENY AND REPRODUCTION. Gestation is 139 days long (van Ee, 1966). Mating and birthing seasons are undoc-

umented, but a female *M. temminckii* killed in May had a fetus of 8.1 g and a female (8.2 kg) killed in July had a male fetus of 113.8 g. There were no fetuses in females killed in December and February (Coulson, 1989). This suggests that the mating season is in late summer to early autumn (e.g., March to May south of the equator) and the birthing season is in winter (e.g., June to September south of the equator; Anonymous, 1989*a*; Smithers, 1983). Females give birth to one young per year (Nowak and Paradiso, 1983; Sclater, 1878; van Ee, 1966). A lactating female, accompanied by a half grown but still suckling offspring, was carrying a well-developed fetus (Sweeney, 1974). This shows that females continue to nurse their young well into their development and that they mate and become pregnant while still nursing young from the previous year.

A Cape pangolin was born at the zoo in Bloemfontein, South Africa, to a pair of *M. temminckii* that had been in captivity for 14 months. When first noticed it was 17.8 cm long and weighed 425 g. At 3 months it was 1.9 kg and at 1 year it weighed 3.46 kg. A second pair gave birth to a 15.2-cm long, 340-g baby. Eyes were open at birth. At 4 weeks of age the offspring rode on the mother's back and was observed taking termites for the first time. It started eating the artificial diet supplied the adults at 35 days. The new mothers were protective of the young and when approached they stood on their hind legs and attacked. Females held their young close to their ventrum and curled protectively around it (van Ee, 1966, 1978).

Individuals successful at keeping *M. temminckii* in captivity have allowed them to forage in the wild (Sweeney, 1956, 1974). This is also true for successes in captive breeding in this species (van Ee, 1966, 1978).

ECOLOGY. *Manis temminckii* inhabits savannah and woodland (Kingdon, 1974) with annual rainfall of 250–1,400 mm (Anonymous, 1989*a*). This species avoids forests and areas of high rainfall where it is replaced by *M. gigantea*. *M. temminckii* also avoids swamps and grassland, and both African ground pangolins avoid desert and semi-desert areas (Stuart, 1980). In South Africa *M. temminckii* occurs in the bushveld areas in Transvaal, Natal, and Cape Province (Acocks, 1953). In Namibia it occurs in thornbush savanna, tree savanna, woodland highveld savanna, camelthorn savanna, mopane savanna and mountain savanna (Giess, 1971; Stuart, 1980). Cape pangolins often live near a water source, are good swimmers, and sometimes wallow in mud. They live in areas where standing water is available only seasonally (Stuart, 1980).

Manis temminckii feeds exclusively on ants and termites (Kingdon, 1974; Smithers, 1971; Sweeney, 1956; Vossler, 1907). Direct observations (Jacobson et al., 1991) and stomach samples from *M. temminckii* (Coulson, 1989) revealed the following Hymenoptera: unidentified Formicidae (9 stomachs), *Acantholepis capensis*, *Anoplepsis custodiens* (3 stomachs), *Anoplepsis* sp. (stomach), *Camponotus eugeniae*, *Camponotus thales* (1 stomach), *Camponotus* sp? (1 stomach), *Crematogaster amita*, *Monsmorium albopilosum*, *Myrmicania natalensis*, *Paltothyreus tarsatus* (1 stomach), *Pheidole megacephala*, *Polyrhachis, schistacea*, *Tapenonia luteum*, *Technomyremex albipes*, and *Xiphomyremex weitiaekeri*. Isoptera found included *Odontotermes badrus*, *Odontotermes transvaalensis* (1 stomach), *Odontotermes* sp? (1 stomach), *Trinervitermes* sp? (2), and *Trinervitermes rhodesiensis* (1 stomach). Termitidae included humus feeders and possibly *Alyscotermes* sp? or *Astalotermes* sp? (Jacobson et al., 1991).

Two captive Cape pangolins followed on nightly foraging excursions in Sudan were highly selective about their prey (Sweeney, 1956). Immature forms of ants and termites were eaten. Favored prey were *Crematogaster*, *Odontotermes*, and *Microcerotermes*, but *Microtermes*, *Amitermes*, and *Ancistotermes* were also eaten. The pangolin avoided both the common *Trinervitermes* which have a strong odor and *Macrotermes bellicosus* which build hard mound nests protected by soldier ants. Sweeney (1956) lists 30 species of ants and termites that *M. temminckii* avoids. *M. temminckii* does not dig for prey as much as other ground pangolins, but searches through surface detritus and explores cracks in the soil (Kingdon, 1974; Sweeney, 1956). These pangolins inspected every cow-pat encountered and apparently could tell from its odor whether it contained termites.

Radio-tracking indicated that *M. temminckii* used a series of bases from which to forage. One female foraged in a given area for 11 days, then moved over 5 days to a new area where it foraged for several more days (Jacobson et al., 1991). This female was seen foraging in areas where she had previously foraged. Foraging excursions lasted up to 6 h. It is unclear whether *M. temminckii* maintains a home range and repeatedly uses the same burrow sites, or if it migrates over a large range without a defined home range.

Manis temminckii live in burrows dug by ant bears (*Orycteropus afer*) into the base of a termitarium or in sandy soil, or dug by spring hares (*Pedetes capensis*). They were never observed digging their own burrows (Jacobson et al., 1991). Cape pangolins do not burrow in clay (Sweeney, 1974). Although Kingdon (1974) states that *M. temminckii* uses the same burrow for many months, more recent radio-telemetry tracking observations suggests that they use a burrow only for several days at a time (Jacobson et al., 1991). A burrow described by Sweeney (1974) had an entrance 20–25 cm in diameter and a 3–5-m long tunnel that sloped steeply downward with the end of the tunnel about 1 m below the entrance level. Most burrows are dug in raised ground so that flooding is not a problem. The Cape pangolin does not dig as many burrows as other species of ground pangolin, perhaps because it lives in a dry habitat where the soil is very hard (Sweeney, 1974).

Kingdon (1974) reports that the feces are black or brown and sausage-shaped, have a strong odor, and contain much earth. Sweeney (1974), who has studied Cape pangolins in the wild and kept them in captivity, reports that *M. temminckii* feces are tiny rounded or irregular pellets consisting largely of the chitinous remains of prey. *M. temminckii* have been observed to leave wet marks of urine on rocks they traverse (Jacobson et al., 1991).

Manis temminckii is listed on Appendix I of the Convention of International Trade in Endangered Species. In Zimbabwe it is listed as a Specially Protected Animal under the 1975 Parks and Wildlife Act (Coulson, 1985) and is protected by law in most other southern African countries (Stuart, 1980). There is, however, conflict between laws protecting pangolins and the traditions of native peoples. Of 37 reported cases of mortality in Zimbabwe, poaching accounted for 21 deaths (Coulson, 1989).

In Zimbabwe, it is a good omen to see a pangolin and it is traditional to catch pangolins and present them to superiors (Anonymous, 1989*b*). Thus, many people believe pangolins should be captured and given to a local chief to be eaten, to a spirit medium (n'anga), or to a rainmaker (Coulson, 1985). In recent years there have been many instances of people capturing pangolins to present them to the President or Prime Minister (Anonymous, 1989*b*; Coulson, 1985). People from eastern Africa believe that burning pangolin scales keeps lions away (Kingdon, 1974; Wright, 1954). In Tanzania the pangolin is known as a doctor, bwana mganga, because each part of it is believed to have some specific healing power (Wright, 1954).

In South Africa *M. temminckii* is thought to be threatened/rare (Bothma, 1975) and its population may be declining (Stuart, 1980). In Malawi the Cape pangolin is thought to be rare (Bothma, 1975) and endangered because of its importance to witch-doctor pharmacopoeia (Stuart, 1980). In other southern African countries it is apparently safe (Bothma, 1975). In Zimbabwe it is safe in protected areas and coexists with cattle ranches, but disappears from areas used for plant crops and areas of dense human population (Coulson, 1989). The Cape pangolin is widespread in east Africa, being numerous in some areas and rare in others (Kingdon, 1974). It is not numerous in Tanzania (Vesey-FitzGerald, 1964). Density of the Cape pangolin may be related to the abundance of prey. It is numerous enough to be considered safe in Kenya (Kingdon, 1974). *M. termminckii* occurs in the south, west, and eastern regions of Sudan and is common in suitable habitat in and around the Nuba Mountains (Sweeney, 1974).

Cape pangolins often have heavy infestations of ticks. One captive pair died after being treated with a dichloro-diphenyl-trichloro-ethane solution to remove ticks (van Ee, 1966, 1978). Another pair died when they were transferred to an enclosure that had been cleaned a month earlier with soluble Lindane, which contains benzene hexachloride (van Ee, 1966, 1978). Both of these cases demonstrate a high sensitivity of this species to chemicals and highlight a possible danger to the species from chemicals used on crops.

BEHAVIOR. Cape pangolins are solitary and nocturnal, but show crepuscular activity in winter (Jacobson et al., 1991). They normally walk slowly and are capable of bipedal walking and running (Kingdon, 1974). When walking quadrupedally they put weight on the knuckles of their forefeet and curl their nails inward and caudally, like South American anteaters. While walking, their head sways from side to side and their tail drags on the ground behind them, often leaving a trail in the substrate. When foraging, they often put

most of their weight on the hind legs, shuffling along bipedally by balancing with their tail (Sweeney, 1974). They walk several kilometers nightly (Kingdon, 1974). Pangolins are also capable swimmers and avid climbers. Females carry their offspring clinging to their backs. Subadult pangolins hold on to the female's shoulder region with the forefeet, straddling her back with their hind feet, and hooking the end of their tail under the base of her tail (Locke, 1989; Smithers, 1983, 1986; Sweeney, 1974). Others report that very young pangolins hang on to the base of the tail (Nowak and Paradiso, 1983; Sweeney, 1956). A female of about 12 kg was observed carrying a juvenile ¼ her mass (Smithers, 1983), and a female of 8 kg was observed carrying a 2.4-kg juvenile (Jacobson et al., 1991). There is considerable effort put into this behavior, which must be adaptive or increase survival rate. It would be adaptive if the offspring learns foraging behavior or if *M. temminckii* is migratory, and it would increase survival if the female affords more protection to the young than would a burrow. Young pangolins sometimes take refuge under the mother's body (Anonymous, 1989*a*; Lang, 1956).

While foraging, Cape pangolins continually sniff, relying on their olfactory sense to find prey. When a nest of ants or termites is located, *M. temminckii* opens it using its front claws and forelegs. The holes of the nest are sniffed and the tongue is inserted into those containing large quantities of insects. While feeding, the pangolin remains still until the supply of ants is exhausted, then repeats the process. The ant and termite nests are not completely destroyed, and the colonies should be able to quickly rebuild the nests and replace the individuals consumed (Jacobson et al., 1991). Sweeney (1956, 1974) observed Cape pangolins feed from cow-pats. *M. temminckii* is extremely selective in feeding. Even when several invertebrate species are present in the same cow-pat or crack, it selects only those which it prefers and selectively ingests larvae and eggs while avoiding swarming workers and pupae (Sweeney, 1974).

Pangolins normally sleep curled up and with their scales open (van Ee, 1978). If the Cape pangolin is disturbed, however, the scales may close with such force as to injure any fingers caught between them. A female pangolin was observed to lie in the shade on her back thus exposing her belly, which was wet from sweat or urine. This behavior allowed the animal to cool itself, and was observed several times on a very hot day (Jacobson et al., 1991).

Copulation was observed in a pair of captive *M. temminckii* at the Bloemfontein Zoo, South Africa. The male mounted the female from the side, entwining her tail with his and positioning his hind parts under hers (van Ee, 1978).

Cape pangolins respond to noise by freezing in the defensive posture of putting their head between their hind legs, thus presenting the scales of the dorsal region to predators. They roll into a sphere when disturbed directly.

REMARKS. Although *M. temminckii* has the widest distribution of any African pangolin, it is the least studied. Detailed descriptions of the habitat used by *M. temminckii* and its availability, information about the size and density of the current population and verification of breeding and birthing seasons are needed. Little is known about its natural history, ecology, physiology, or behavior. There is no information on the genetics of *M. temminckii*.

Common names for *M. temminckii* include: Temminck's Ground Pangolin (after Prof. C. J. Temminck, a Dutch zoologist); Steppenschuppentier (German); ietermagog (Afrikaans); Kakakuona (Swahili); pangolin terrestre du Cap (French; Haltenorth and Diller, 1977); okong (Lwo); amikimek (Ateso); amekek (Karamajong); wakawaka (Madi; Kingdon, 1974); haka (Shona); inkakha (Ndebele), and umm girfer in Sudan.

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